

\$1.95

THE APPLETM REFERENCE CARD

APPLE is a TM of APPLE Computer, Inc.

being
A COMPLETE CHARACTER CODE LIST WITH
SCREEN AND KEYBOARD ASSIGNMENTS
together with
OP CODES ARRANGED ALPHABETICALLY &
NUMERICALLY
to which is appended
ENTRY POINTS TO USEFUL MONITOR SUB-
ROUTINES
including
SELECTED BASIC TOKENS, A MEMORY MAP,
and
A TABLE TO TAKE YOU FROM BINARY TO
HEX TO DECIMAL AND BACK

COMPU SHOP

COMPUTERS FOR HOME & BUSINESS

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USEFUL MONITOR SUBROUTINES

INPUT	(KEY)	JSR	CALL
Read Tape	(R)	FEFD	-259
Wait for input		FD6F	-657
Prompt and Wait for input		FD6A	-662
Line-feed, Prompt, and wait for input		FD67	-665
Get a character		FD35	-715
OUTPUT			
Bell	(C _G)	FF3A	-198
Write Tape	(W)	FECA	-310
Disassemble 20 instructions	(L)	FE5E	-418
Display character, update screen location		FDFB	-517
Display character, mask control character, save Y register & Accumulator		FDED	-531
Display contents of accumulator in hex		FDDA	-550
Display character only		FBFO	-1024
Display all registers in hex	(C _E)	FAD7	-1321
Disassemble one instruction		F8D0	-1840
Toggle Speaker		C030	-16336
Toggle Output		C020	-16352
CURSOR CONTROL			
Clear to end of line	(E _E)	FC9C	-868
Cursor DOWN one	(E _C)	FC66	-922
Home and Clear	(E _H)	FC58	-936
Clear to end of screen	(E _F)	FC42	-958
Cursor UP one	(E _D)	FC1A	-998
Cursor LEFT one	(E _B)	FC10	-1008
Cursor RIGHT one	(E _A)	FBF4	-1036
Drop Cursor to bottom of screen		FB2F	-1233
GRAPHICS			
Text & Graphics Mode		FB40	-1216
Clear Graphics		F832	-1998
Vertical Line		F828	-2007
Horizontal Line		F819	-2023
Text Mode	(TEXT)	C051	-16303
Graphics Mode	(GR)	C050	-16304
OTHER			
Enter Monitor and Continue		FF65	-155
Enter Monitor and Reset	(RESET)	FF59	-167
Normal Screen Mode	(N)	FE84	-380
Inverse Screen Mode	(I)	FE80	-384
Verify (Compare & List differences)	(V)	FE36	-458
Move	(M)	FE2C	-484
ADD	(+)	FDC6	-570
SUBTRACT	(-)	FDC6	-570
Scroll Screen		FC70	-912
Line Feed	(C _J)	FC66	-922
Enter Assembler		F666	-2458
Enter BASIC and continue	(C _C)	E003	-8189
Enter BASIC and reset	(C _B)	E000	-8192

BASIC COMMAND TOKENS

COMMAND	TOKEN	CALL
AUTO	0D	(AUTO LINE NUMBERING)
CLR	0C	(CLEAR VARIABLES)
DEL	09	(DELETE LINES)
HIMEM:	10	(SET HIMEM)
LOAD	04	-3973 (LOAD INTEGER)
LOMEM:	11	(SET LOMEM)
MAN	0F	(TURNS OFF AUTO)
NEW	0B	(SCRATCHES PROGRAM)
RUN	07	-6090 (RUN INTEGER)
SAVE	05	-3776 (SAVE INTEGER)

MEMORY MAP

Page Zero

00-1F: Used by SWEET16; See article in BYTE, November 1977, pages 150-159.
20-23: Screen window: left, width, top, bottom.
24-25: Cursor location: horizontal, vertical
26-27: Graphics screen pointer.
28-29: Next character on screen address.
2A-2B: Auxiliary screen pointer.
2C-2F: Miscellaneous.
30-33: Color, Mode, Inverse Flag, Prompt Characters
35-39: Miscellaneous.
3A-3B: Program counter store.
3C-45: Address stores A1-A5.
45-49: Stores for: Accumulator, X and Y registers, Status, and Stack Pointer.
4A-4D: BASIC LOMEM, BASIC HIMEM.
4E-4F: Stores number of keystrokes.
50-55: Integer multiply/divide workspace.
56-5F: BASIC Workspace.
F0-FF: Floating Point routines workspace.
CA-CB: Address of start of program (BASIC).
CC-CD: Address of end of variable table (BASIC).

Page One: BASIC gosubs and fors, Subroutine return stack.

Page Two: Character input buffer.

Pages Four through Seven - Text or color graphics.
Starting addresses for screen lines are:
Lines 1- 8: 400,480,500,580,600,680,700,780.
Lines 9-16: 428,4A8,528,5A8,628,6A8,728,7A8.
Lines 17-24: 450,4D0,550,5D0,650,6D0,750,7D0.
Note: Assembly code programs usually use 00-1F and 50-FF in Zero-page and 0800-BFFF for program & data.

C-Block: I/O path. Caution: HERE BE DRAGONS.
D-Block: Available for added ROM's or PROM's.
E-Block: Integer BASIC.
F-Block: End of Integer BASIC, Floating point routines, Assembler, Interpreter, Monitor.

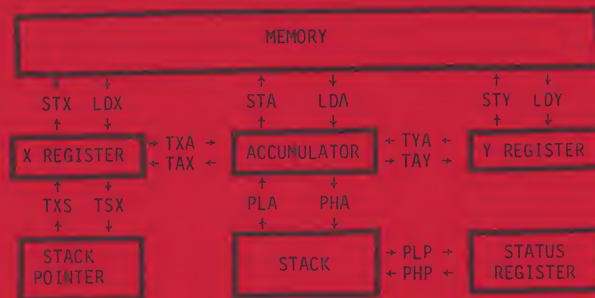
BINARY TO HEX TO DECIMAL AND BACK

BINARY	HEX	1	2	3	4	HEX	HEX ^C
0000	0	0	0	0	0	0	F
0001	1	4096	256	16	1	1	E
0010	2	8192	512	32	2	2	D
0011	3	12288	768	48	3	3	C
0100	4	16384	1024	64	4	4	B
0101	5	20480	1280	80	5	5	A
0110	6	24576	1536	96	6	6	9
0111	7	28672	1792	112	7	7	8
1000	8	32768	2048	128	8	8	7
1001	9	36864	2304	144	9	9	6
1010	A	40960	2560	160	10	A	5
1011	B	45056	2816	176	11	B	4
1100	C	49152	3072	192	12	C	3
1101	D	53248	3328	208	13	D	2
1110	E	57344	3584	224	14	E	1
1111	F	61440	3840	240	15	F	0

To convert from HEX to DECIMAL add one figure from each column to obtain total. Thus: 4FC2 = 16384 + 3840 + 192 + 2 = 20418. If first hex digit is > 7, subtract 65,536 (giving a negative result).

To convert from DECIMAL to HEX, subtract largest number in first column that produces nonnegative result, then largest number from second column, etc. noting hex codes along the way. If decimal is negative, first add 65,536. Thus 31,015 - 28,672(7) = 2343 - 2304(9) = 39 - 32(2) = 7(7). Or 31,015_{dec} = 7,927_{hex}.

TRANSFER OPERATIONS



OTHER OPERATIONS

Arithmetic: Add with carry (preceded with CLC): ADC
 Subtract with borrow (preceded with SEC): SBC; Increment memory (INC), X register (INX), Y register (INY);
 Decrement memory (DEC), X register (DEX), Y register (DEY).
 Logical: And memory with accumulator (AND); Or memory with accumulator (ORA); Exclusive-Or memory with accumulator (EOR); Test bits in memory with accumulator (BIT).
 Shift: Shift left one bit (ASL), right one bit (LSR); Rotate left one bit (ROL), right one bit (ROR).
 Compare: Compare memory with accumulator (CMP), X register (CPX), Y register (CPY).
 Branch: Branch on carry clear (BCC), carry set (BCS), zero (BEQ), minus (BMI), not equal (BNE), not minus (BPL), overflow clear (BVC), overflow set (BVS).
 Clear: Clear carry (CLC), decimal (CLD), interrupt (CLI), overflow (CLV).
 Set: Set carry (SEC), decimal (SED), interrupt (SEI).
 Jump: Jump (JMP); jump to subroutine (JSR).
 Return: Return from subroutine (RTS), from interrupt (RTI).
 Other: No operation (NOP); break (BRK).

HEX OPERATION CODES

FIRST HEX DIGIT															
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 BRK BPL JSR NMI RTI BVC RTS BVS ? BCC LDY BCS CPY BNE CPX BEQ	1 ORA ORA AND AND EOR EOR ADC ADC STA STA LDA LDA CMP CMP SBC SBC	2 ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?	3 ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?	4 ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?	5 ORA ORA AND AND EOR EOR ADC ADC STA STA LDA LDA CMP CMP SBC SBC	6 ASL ASL ROL ROL LSR LSR ROR ROR STX STX LDX LDX DEC DEC INC INC	7 ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?	8 PHP CLC PLP SEC PHA CLI PLA SEI DEY TYA TAY CLV INY CLD INX SED	9 ORA ORA AND AND EOR EOR ADC ADC ? STA LDA LDA CMP CMP SBC SBC	A ASL ? ROL ? LSR ? ROR ? TXA TXS TAX TSX DEX ? NOP ?	B ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?	C ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?	D ORA ORA AND AND EOR EOR ADC ADC STA STA LDA LDA CMP CMP SBC SBC	E ASL ASL ROL ROL LSR LSR ROR ROR STX ? LDX LDX DEC DEC INC INC	F ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?

? Treated by machine as NOP, disassembler prints: ???

STATUS BITS															
Immediate	Zero Page	Zero Page	Absolute	Absolute	Absolute	(Indirect)	(Indirect)	Implied	Relative	N V - B D I Z C					
ADC	69	65	75	6D	7D	79	61	71		✓	✓		✓	✓	✓
AND	29	25	35	2D	3D	39	21	31		✓			✓	✓	✓
ASL	06	16	0E	1E				0A		✓					
BCC									90						
BCS									80						
BEQ									F0						
BIT	24		2C							M ₇	M ₆				
BMI									30						
BNE									D0						
BPL									10						
BRK								00					1		
BVC									50						
BVS									70						
CLC									18						
CLD									D8			0			
CLI									58				0		
CLV									B8		0				
CMP	C9	C5	D5	CD	DD	D9	C1	D1		✓			✓	✓	✓
CPX	E0	E4		EC						✓			✓	✓	✓
CPY	C0	C4		CC						✓			✓	✓	✓
DEC		C6	D6	CE	DE					✓			✓	✓	✓
DEX								CA		✓			✓	✓	✓
DEY								B8		✓			✓	✓	✓
EOR	49	45	55	4D	5D	59	41	51		✓			✓	✓	✓
INC		E6	F6	EE	FE					✓			✓	✓	✓
INX								E8		✓			✓	✓	✓
INY								C8		✓			✓	✓	✓
JMP			4C												
JMP	(Indirect)			6C	(3bytes)										
JSR			20												
LDA	A9	A5	B5	AD	BD	B9	A1	B1		✓			✓	✓	✓
LDX*	A2	A6		AE	BE					✓			✓	✓	✓
LDY	A0	A4	B4	AC	BC					✓			✓	✓	✓
LSR		46	56	4E	5E			4A		0			✓	✓	✓
NOP								EA							
ORA	09	05	15	0D	1D	01	11			✓			✓	✓	✓
PHA								48							
PHP								08							
PLA								68		✓	✓	✓	✓	✓	✓
PLP								28		✓	✓	✓	✓	✓	✓
ROL		26	36	2E	3E			2A		✓			✓	✓	✓
ROR		66	76	6E	7E			6A		✓			✓	✓	✓
RTI								40		✓	✓	✓	✓	✓	✓
RTS								60							
SBC	E9	E5	F5	ED	FD	F9	E1	F1		✓	✓		✓	✓	✓
SEC								38							
SED								F8				1			
SEI								78					1		
STA		85	95	8D	9D	99	81	91							
STX*		86		8E											
STY		84	94	8C											
TAX								AA		✓			✓	✓	✓
TAY								AB		✓			✓	✓	✓
TSX								BA		✓			✓	✓	✓
TXA								8A		✓			✓	✓	✓
TXS								9A		✓			✓	✓	✓
TYA								98		✓			✓	✓	✓
bytes	2	2	2	3	3	3	2	2	1	2					

*LDX Zero Page, Y 86 (2 bytes)
 *STX Zero Page, Y 96 (2 bytes)

HEX CODE	ASCII CODE	SCREEN INVERSE	HEX CODE	ASCII CODE	SCREEN FLASHING	HEX CODE	ASCII CODE	SCREEN NORMAL	KEY ASSIGNMENT	HEX CODE	ASCII CODE	SCREEN NORMAL	KEY ASSIGNMENT
00 NULL	@		40 @	@		80 NULL	@			C0			
01 SOH	A		41 A	A		81 SOH	A			C1			
02 STX	B		42 B	B		82 STX	B			C2			
03 ETX	C		43 C	C		83 ETX	C			C3			
04 EOT	D		44 D	D		84 EOT	D			C4			
05 ENQ	E		45 E	E		85 ENQ	E			C5			
06 ACK	F		46 F	F		86 ACK	F			C6			
07 BELL	G		47 G	G		87 BELL	G			C7			
08 BS	H		48 H	H		88 BS	H			C8			
09 HT	I		49 I	I		89 HT	I			C9			
0A LF	J		4A J	J		9A LF	J			CA			
0B VT	K		4B K	K		9B VT	K			CB			
0C FF	L		4C L	L		9C FF	L			CC			
0D CR	M		4D M	M		9D CR	M			CD			
0E SO	N		4E N	N		9E SO	N			CE			
0F SI	O		4F O	O		9F SI	O			CF			
10 DLE	P		50 P	P		90 DLE	P			D0			
11 DC1	Q		51 Q	Q		91 DC1	Q			D1			
12 DC2	R		52 R	R		92 DC2	R			D2			
13 DC3	S		53 S	S		93 DC3	S			D3			
14 DC4	T		54 T	T		94 DC4	T			D4			
15 NAK	U		55 U	U		95 NAK	U			D5			
16 SYN	V		56 V	V		96 SYN	V			D6			
17 ETB	W		57 W	W		97 ETB	W			D7			
18 CAN	X		58 X	X		98 CAN	X			D8			
19 EM	Y		59 Y	Y		99 EM	Y			D9			
1A SUB	Z		5A Z	Z		9A SUB	Z			DA			
1B ESC	[		5B [	[		9B ESC	[	ESC		DB			
1C FX	\		5C \	\		9C FS	\			DC			
1D GS	]		5D ]	]		9D GS	]			DD			
1E RS	^		5E ^	^		9E RS	^			DE			
1F US	+		5F +	+		9F US	+			DF			
20 Space			60			A0 Space				E0			
21 !	!		61 a	!		A1	!			E1			
22 "	"		62 b	"		A2	"			E2			
23 #	#		63 c	#		A3	#			E3			
24 \$	\$		64 d	\$		A4	\$			E4			
25 %	%		65 e	%		A5	%			E5			
26 &	&		66 f	&		A6	&			E6			
27 '	'		67 g	'		A7	'			E7			
28 (	(		68 h	(		A8	(			E8			
29 )	)		69 i	)		A9	)			E9			
2A *	*		6A j	*		AA	*			EA			
2B +	+		6B k	+		AB	+			EB			
2C ,	,		6C l	,		AC	,			EC			
2D -	-		6D m	-		AD	-			ED			
2E .	.		6E n	.		AE	.			EE			
2F /	/		6F o	/		AF	/			EF			
30 0	0		70 p	0		B0	0			F0			
31 1	1		71 q	1		B1	1			F1			
32 2	2		72 r	2		B2	2			F2			
33 3	3		73 s	3		B3	3			F3			
34 4	4		74 t	4		B4	4			F4			
35 5	5		75 u	5		B5	5			F5			
36 6	6		76 v	6		B6	6			F6			
37 7	7		77 w	7		B7	7			F7			
38 8	8		78 x	8		B8	8			F8			
39 9	9		79 y	9		B9	9			F9			
3A :	:		7A z	:		BA	:			FA			
3B ;	;		7B [	;		BB	;			FB			
3C <	<		7C |	<		BC	<			FC			
3D =	=		7D]	=		BD	=			FD			
3E >	>		7E ^	>		BE	>			FE			
3F ?	?		7F DEL	?		BF	?			FF DEL			

*A = Control A; *M = Shift M